

Amazon Rainforest Fires: Impact on Global Environment

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Abstract

Fire in the forests is currently very common. A vivid example of this is fire in the Amazon rainforest. Wildfire often occurring in the dry season in Brazil, but this year has been worse than normal according to INPE. Fires are deliberately started in efforts to illegally deforest land for cattle ranching. The space agency said it has detected more than 72000 fires between January and August mostly in Amazon region. Fires release pollutants, including particulate matter & toxic gases such as carbon monoxide, nitrogen oxides and non-methane organic compounds into the atmosphere. In forest fire all the nutrients are lost because they are stored in the plants themselves, not in the soil. The plants and animals lack a natural ability to resist and recover from fire. Species of flora and fauna are found here which are not found in any other rainforest of the world. The importance of Amazon rainforest for ecology is as much in the production of oxygen. About 400 to 500 Amerindian tribes live here. It is believed that about 50 of these tribes have never had contact with the outside world. The socio and cultural life of these tribes is under threat. Beyond the human and ecological impact, there are huge consequences for business such as trade deal will be in doubt, sustainability initiative, supply risk, pharmaceutical supply will be in risk. In this way the fire in Amazon rainforest has affected the ecosystem and the environment in the same way, it has also affected the society, culture and economy.

Keywords: Eocene era, Climate fluctuations, Global warming, MODIS, WWF, INPE, Indigenous tribes, ENGO'S, Queimada, GFEP, NASA, CSIC, Flame Retardants, SEURFF, OMPE.

Introduction

The Amazon rainforest, also known in English as Amazonia or the Amazon Jungle, is a moist broadleaf tropical rainforest in the Amazon biome that covers most of the Amazon basin of South America. This basin encompasses 7,000,000 sq km (2,700,000 sq mi), of which 5,500,000 sq km (2,100,000 sq mi) are covered by the rainforest. This region includes territory belonging to nine nations. Brazil, Peru, Colombia, Venezuela, Ecuador, Bolivia, Guyana, Suriname, France (French Guiana) Area 5,500,000 sq km (2,100,000 sq mi) The majority of the forest is contained within Brazil, with 60% of the rainforest, followed by Peru with 13%, Colombia with 10%, and with minor amounts in Venezuela, Ecuador, Bolivia, Guyana, Suriname and French Guiana. Four nations have "Amazonas" as the name of one of their first-level administrative regions and France uses the name "Guiana Amazonian Park" for its rainforest protected area. The Amazon represents over half of the planet's remaining rainforests, and comprises the largest and most biodiverse tract of tropical rainforest in the world, with an estimated 390 billion individual trees divided into 16,000 species.

Aim of study

In this article, we will discuss the environmental and geopolitical background of the Amazon rainforest followed by an analysis of forest fire data from previous years as well as new information from published research about the 2019 forest fires and their future ramifications.

Etymology

The name Amazon is said to arise from a war Francisco de Orellana fought with the Tapuyas and other tribes. The women of the tribe fought alongside the men, as was their custom. Orellana derived the name Amazonas from the Amazons of Greek mythology, described by Herodotus and Diodorus

History

Tribal societies are well capable of escalation to all-out wars between tribes. Thus, in the Amazonas, there was perpetual animosity between the neighboring tribes of the Jivaro. Several tribes of the Jivaroan group, including the Shuar, practiced headhunting for trophies and head shrinking.[5] The accounts of missionaries to the area in the borderlands between Brazil and Venezuela have recounted constant infighting in the Yanomami tribes. More than a third of the Yanomamo males, on average, died from warfare.



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During the Amazon rubber boom it is estimated that diseases brought by immigrants, such as typhus and malaria, killed 40,000 native Amazonians.

Location

Nine countries share the Amazon basin—most of the rainforest, 58.4%, is contained within the borders of Brazil. The other eight countries include Peru with 12.8%, Bolivia with 7.7%, Colombia with 7.1%, Venezuela with 6.1%, Guyana with 3.1%, Suriname with 2.5%, French Guyana with 1.4%, and Ecuador with 1%.

The rainforest likely formed during the Eocene era (from 56 million years to 33.9 million years ago). It appeared following a global reduction of tropical temperatures when the Atlantic Ocean had widened sufficiently to provide a warm, moist climate to the Amazon basin. The rainforest has been in existence for at least 55 million years, and most of the region remained free of savanna-type biomes at least until the current ice age when the climate was drier and savanna more widespread.

Review of Literature Following the Cretaceous

Paleogene extinction event, the extinction of the dinosaurs and the wetter climate may have allowed the tropical rainforest to spread out across the continent. From 66–34 Mya, the rainforest extended as far south as 45°. Climate fluctuations during the last 34 million years have allowed savanna regions to expand into the tropics. During the Oligocene, for example, the rainforest spanned a relatively narrow band. It expanded again during the Middle Miocene, then retracted to a mostly inland formation at the last glacial maximum. However, the rainforest still managed to thrive during these glacial periods, allowing for the survival and evolution of a broad diversity of species.

The 2019 Amazon rainforest wildfires season saw a year-to-year surge in fires occurring in the Amazon rainforest and Amazon biome within Brazil, Bolivia, Paraguay, and Peru during that year's Amazonian tropical dry season. Fires normally occur around the dry season as slash-and-burn methods are used to clear the forest to make way for agriculture, livestock, logging, and mining, leading to deforestation of the Amazon rainforest. Such activity is generally illegal within these nations, but enforcement of environmental protection can be lax. The increased rates of fire counts in 2019 led to international concern about the fate of the Amazon rainforest, which is the world's largest carbon dioxide sink and plays a significant role in mitigating Global Warming.

To the naked eye, the fires appear randomly distributed throughout the forest. But, if you overlay the ECOSTRESS data, you can see that the fires are mainly confined within the highly water-stressed areas. The fires avoided the low-stress areas where the forest appears to have access to more water." — Josh Fisher, ECOSTRESS science lead at NASA's Jet Propulsion Laboratory. It is still unknown why certain plants become stressed whilst others do not, but it is suspected to depend on aspects such as plant species or water content of the soil.

Global Forest Watch

One of the best resources to study fires is the Global Forest Watch, which provides a dashboard GUI to study changes in climate, land-use, and other variables that influence forest ecosystems. We can use the Global Forest Watch Fires to analyze fires specifically. If one looks at the number of fires alerts by province between June 1st and the end of November 2019, the majority of fires are occurring in the states that are part of the Amazon rainforest. The same database also tells us the proportion of these fires that were set on WDPA projected areas, which is 18–20% depending on the time period analyzed. We can also distinguish between fires that happen within intact forest landscape areas and those that happen in places that have already been disturbed. A fire in a previously untouched part of the forest will have a bigger impact on biodiversity than a fire that's happening on a farmer's plot of cultivated land. We can also look at the seasonal progression of fires and see how it compares to previous years using MODIS fire alerts. Fires are more prevalent towards the end of the year as this is when the dry season peaks. We see that 2019 was not a particularly bad year in terms of the number of fire alerts compared to some years. However, the worst years occurred in years associated with El Niño and severe droughts, or the aftermath of such years when the ecosystem is still recovering. We can also assess how 'unusual' the fire alerts were for a given month based on the MODIS data. It seems from the results that August and September had particularly high fire alerts compared to the rest of the year, which were below average compared to previous years during the dry season. The steep drop off in fires after September could be partly due to the 2-month moratorium put in place by president Bolsonaro to tackle the fires after growing international pressure.

VIIRS

We can also analyze the fires using the Visible Infrared Imaging Radiometer Suite (VIIRS), one of the key instruments onboard the Suomi National Polar-Orbiting Partnership (Suomi NPP) spacecraft. The data from VIIRS can be combined with information about how many fires were occurring within intact forest landscapes, which have a greater impact on emissions and their influence on biodiversity, as previously discussed.

The VIIRS data tells us that many fires were occurring in Rondonia whilst relatively few were happening in Amazonas. This data corroborates well with the data from the Global Forest Watch which tells us that only 4% of fires occurred within intact forest landscapes.

2019 Amazon rainforest wildfires

Locations of fires, marked in orange, which were detected by MODIS from August 15 to August 22, 2019 Location Brazil, Bolivia, Peru, Paraguay Burned area 906,000 hectares (2,240,000 acres) Cause Slash-and-burn approach to deforest land for agriculture and effects of climate change due to unusually longer dry season and above average temperatures around worldwide during July and August Land useAgricultural development Fatalities Amazon rainforest eco regions as delineated by the WWF in white and the Amazon drainage basin in blue.

The increasing rates were first reported by Brazil's National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais, INPE) in June and July 2019 through satellite monitoring systems, but international attention was drawn to the situation by August 2019 when NASA corroborated INPE's findings, and smoke from the fires, visible from satellite imagery, darkened the city of São Paulo despite being thousands of kilometers from the Amazon. As of August 29, 2019, INPE reported more than 80,000 fires across all of Brazil, a 77% year-to-year increase for the same tracking period, with more than 40,000 in the Brazil's Legal Amazon (Amazônia Legal or BLA), which contains 60% of the Amazon. Similar year-to-year increases in fires were subsequently reported in Bolivia, Paraguay and Peru, with the 2019 fire counts within each nation of over 19,000, 11,000 and 6,700, respectively, as of August 29, 2019. It is estimated that over 906 thousand hectares (2.24×10⁶ acres; 9,060 sq km; 3,500 sq mi) of forest within the Amazon biome has been lost to fires in 2019. In addition to the impact on global climate, the fires created environmental concerns from the excess carbon dioxide and carbon monoxide within the fires' emissions, potential impacts on the biodiversity of the Amazon, and threats to indigenous tribes that live within the forest.

The increased rate of fires in Brazil has raised the most concerns as international leaders, particularly French president Emmanuel Macron, and environmental non-government organizations (NGOs) attributed these to Brazilian president Jair Bolsonaro's pro-business policies that had weakened environmental protections and have encouraged deforestation of the Amazon after he took office in January 2019. Bolsonaro initially remained ambivalent and rejected international calls to take action, asserting that the criticism was sensationalist. Following increased pressure from the international community at the 45th G7 summit and a threat to reject the pending European Union–Mercosur free trade agreement, Bolsonaro dispatched over 44,000 Brazilian troops and allocated funds to fight the fires, and later signed a decree to prevent such fires for a sixty-day period.

Other Amazonian countries have been affected by the wildfires in higher or lesser degree. The number of hectares of Bolivian rainforest affected by the wildfires were roughly equal to those of Brazil, being the area of Bolivia only about one-eighth of Brazil's. Bolivian president Evo Morales was similarly blamed for past policies that encouraged deforestation, Morales has also taken proactive measures to fight.

There have been 72,843 fires in Brazil in 2019, with more than half within the Amazon region. In August 2019 there were a record number of fires. Deforestation in the Brazilian Amazon rose more than 88% in June 2019 compared with the same month in 2018.

Agricultural fires in southern Pará, Brazil in August 2019. INPE alerted the Brazilian government to larger-than-normal growth in the number of fires through June to August 2019. The first four months of the year were wetter-than-average, discouraging slash-and-burn efforts. However, with the start of the dry season in May 2019, the number of wildfires jumped greatly. Additionally, NOAA reported that, regionally, the temperatures in the January–July 2019 period were the second warmest year-to-date on record. INPE reported a year-to-year increase of 88% in wildfire occurrences in June 2019. There was further increase in the rate of deforestation in July 2019, with the INPE estimating that more than 1,345 square kilometres (519 sq mi; 134,500 ha; 332,000 acres) of land had been deforested in the

month and would be on track to surpass the area of Greater London by the end of the month.

The month of August 2019 saw a large growth in the number of observed wildfires according to INPE. By August 11, Amazonas had declared a state of emergency.[56] The state of Acre entered into an environmental alert on August 16. In early August, local farmers in the Amazonian state of Pará placed an ad in the local newspaper calling for a *queimada* or "Day of Fire" on August 10, 2019, organizing large scale slash-and-burn operations knowing that there was little chance of interference from the government. Shortly after, there was an increase in the number of wildfires in the region.

INPE reported on August 20 that it had detected 39,194 fires in the Amazon rainforest since January. This represented a 77 percent increase in the number of fires from the same time period in 2018. However, the NASA-funded NGO Global Fire Emissions Database (GFED) shows 2018 as an unusually low fire year compared to historic data from 2004–2005 which are years showing nearly double the number of counted fires. INPE had reported that at least 74,155 fires have been detected in all of Brazil, which represents an 84-percent increase from the same period in 2018. NASA originally reported in mid-August that MODIS satellites reported average numbers of fires in the region compared with data from the past 15 years; the numbers were above average for the year in the states of Amazonas and Rondônia, but below average for Mato Grosso and Pará. NASA later clarified that the data set they had evaluated previous was through August 16, 2019. By August 26, 2019, NASA included more recent MODIS imagery to confirm that the number of fires were higher than in previous years.

INPE satellite imagery of a 70-by-70 mile area along the Purus River between Canutama and Lábrea in the state of Amazonas, taken on August 16, 2019, showing several plumes of smoke from wildfires, including areas that have been deforested.

By August 29, 80,000 fires had broken out in Brazil which represents a 77% rise on the same period in 2018, according to BBC. INPE reported that in the period from January 1 to August 29, across South America, and not exclusive to the Amazon rainforest, there were 84,957 fires in Brazil, 26,573 in Venezuela, 19,265 in Bolivia, 14,363 in Colombia, 14,969 in Argentina, 10,810 in Paraguay, 6,534 in Peru, 2,935 in Chile, 898 in Guyana, 407 in Uruguay, 328 in Ecuador, 162 in Suriname, and 11 in French Guiana.

Fauna and flora upset by forest fires

When the frequency of forest fires in a given area is high, the consequences can be devastating. If some specialists consider fire to be a windfall for the ecosystem (elimination of diseased plants and animals, increased plant and animal diversity, etc.), we must not forget that the natural cycles of forests are disturbed and that some species disappear, while invasive plants proliferate. Forest fires increase carbon dioxide levels in the atmosphere, contributing to the greenhouse effect and climate change. In addition, ashes destroy much of the nutrients and erode the soil, causing flooding and landslides.

The use of chemicals in firefighting adds an additional problem to the already dramatic consequences of forest fires. According to a recent study by the Supreme Council for Scientific Research (CSIC), chemicals contained in "flame retardants" used to extinguish fires (such as Fire-Trol) accumulate in the soil for years. The findings of the study highlight the presence of ammonium polyphosphate, known to alter soil fertility, biodiversity and affect the composition of vegetation. The OMPE is currently studying SEURFF : System of Extinction Ultra Rapids of Forest fires.

An estimated 40,000 plant species, including 16,000 native tree types, with new ones still being discovered on a regular basis, the Amazon Rainforest is one gigantic expanse of greenery and accounts for some 20% of the world's entire allocation of natural forest. Studies have shown that a single square kilometer of Amazon Rainforest can contain upwards of 90,000 tones of living plants. That being said, some of the most interesting and unique species of plants can be found in the Amazon jungle. Rainforest Cruises has put together a list of 10 very cool plants found in the Amazon Rainforest.

**Heliconia Flower
(Lobster-Claw)**

This beautiful amazonian flora is known as the Hanging Lobster Claw. This flower is bright in color and varies in its shape. Known for their characteristically long structure, heliconia plants range from 0.5 to nearly 4.5 meters (1.5–15 feet) tall depending on the species and their leaves are 15–300 cm (6 in-10 ft) in size. They require warm and humid conditions to grow, thus being prominent in the tropical regions of the world. Hummingbirds rely on Heliconia plants for food and nesting, and they are also the main pollinators of the plant.

**Rubber Tree (Hevea
brasiliensis)**

Economically, the rubber tree is one of the most important trees in the Amazon rainforest for indigenous peoples. The rubber tree's sap is latex, and it is still used today in the modern processing of rubber. The rubber tree can reach a height of up to 100 feet (30 m). The inner bark of the tree oozes latex when cut or damaged. It's quite a unique sight to see. Originally this plant was native to the Amazon rainforest, however seeds were eventually illegally smuggled to Southeast Asia where the tree successfully propagated.

Orchids

The orchid flower is known as one of nature's most exquisite flowers. They are also the largest family of flowers in the entire world (about 30,000 different species). Orchids grow in all shapes and sizes, and because of their adaptable nature, they grow in almost all climates around the world, except cold! Orchids, like many flowers, depend on insects and birds for pollination. The conservation of the rainforest is vital for their existence.

**Cacao (Theobroma
cacao)**

Despite being one of the world's favorite desserts, the cacao plant is also a superfood that is loaded with health benefits. Make raw cacao part of your regular diet to benefit from natural energy, mental alertness and focus. Cacao also has more calcium than cow's milk and is the highest plant-based source of iron. It's full of magnesium for a healthy heart and brain.

Giant Water Lilies

If you have ever been on an Amazon River cruise or stayed in a jungle lodge, you may have seen these impressive Victoria water lilies during one of your jungle excursions. These water lilies are not your average flower - they grow up to 3 meters in diameter - imagine, you could lay down on one! They were named after Queen Victoria of the United Kingdom.

**Passion Fruit Flower
(Passiflora)**

The passion fruit flower is a vigorous vine that can cling on to almost anything and grow 15 to 20 ft. a year. This plant does well in tropical climates, and prefers the sun, however, the passion fruit flower does not like heavy heat. If there is too much heat, the passion fruit flower will start growing towards the shade.

**Bromeliads
(Bromeliaceae)**

These beautiful plants are bright in color, varying from reds and oranges to blues and purples. These flowers grow on the ground or on other plants, and even on rocks. Monkey Brush Vine (*Combretum rotundifolium*)
The Monkey Brush is a striking vine native to South America. This exotic plant grows like a parasite on other plants and trees throughout the jungle. The flower acts as a natural feeding source for hummingbirds and a resting spot for green iguanas. The flower is very bright, a vivid orange color that can easily be seen among rainforest greenery. The name Monkey Brush is believed to have come from the flower's long and colorful stamens.

Banana Tree

Bananas are the fourth largest food crop in the world and one of the most popular fruits in the United States. They are vital to our economy and our health. The banana plant is very impressive. Banana blossoms develop into fruit (takes 3-4 months to be ripe enough to eat). After the plant produces fruit, the stem dies and is immediately replaced by new growth. Can you believe that banana plants weigh on average 100 pounds and can have 150 bananas growing at the same time.

Coffee Plant (Coffea)

Most of us couldn't imagine a world without coffee! The coffee plant resembles a bush and can grow up to 30 feet tall. Coffee flowers are very small and fragrant, helping to attract insects for pollination. After the flower falls off the plant, little berries begin to grow. Inside these berries lie the valuable coffee beans which make them one of the most economically important species in the world.

Bizarre Creatures of the Amazon Rainforests

The candiru fish, also known as cañero, toothpick fish, or vampire fish, is a species of parasitic freshwater catfish. Adults can grow up to 16 inches in length, and can be found throughout the Amazon basin. Candirus are known to parasitize the gills of larger fishes and feed off the blood. Shockingly, there have even been reports of candiru entering the urethra of human males! But don't cancel those flights just yet, these reports are always shrouded in controversy, and many people disregard these incidents as myths.

Potoos are a group of birds related to nightjars and frogmouths, and are found throughout the Amazon rainforest. Masters of disguise, they are nocturnal creatures that spend the days motionless, with eyes half open, perched upon the stumps of broken branches. Their stump will be chosen wisely, as it will be the home of their single egg, whose incubating duties are shared by both the male and female in shifts. You will be very lucky to see one however, as their camouflage is extremely effective, especially when combined with their lifeless .

Glass Frog

Glass frogs are members of the Centrolenidae family. While generally green in color, what makes them so intriguing is that their internal organs are visible through the translucent skin on the underside of their body, which takes on the hue of the frogs surroundings, thus making it difficult to see for any would-be predators. They are generally small creatures that range anywhere from 1.2 to 3 inches in length, and have been known to eat their young.

Jesus Lizard

The Jesus Lizard, or common basilisk, has the incredible ability of being able to run on water, hence its name. When fleeing from predators, the lizard opens its toes to reveal a special webbing, and with enough momentum, is able to successfully run across the surface for up to 20 meters! They are found throughout rainforests in Central and north-western South America, usually near water at low elevation.

Bull Shark

While normally a salt-water dwelling creature, bull sharks have been spotted in the freshwaters of the Amazon as far up as Iquitos (almost 2,500 miles from the sea)! Bull sharks are big and heavy, adult females can reach 11 feet in length, and weigh up to 690 lbs. They are able to adapt to either fresh or salt-water environments, and could spend a lifetime in a river system, if it weren't for the necessity of mating. Many experts have labeled bull sharks the most dangerous shark in the world, and are probably responsible for the majority of near coast shark attacks.

Decoy Building Spider

Only recently discovered, the decoy building spider is thought to belong to the genus Cyclosa. This fascinating arachnid is actually incredibly small, around 5 mm in length, but assembles a much larger decoy spider in its web, complete with multiple legs, from dead leaves and debris. It was first discovered at the Tambopata Research Center, and although further investigation is necessary to confirm this, it is thought to be a previously unknown species.

Capybara

Capybara are the largest rodents in the world, weighing up to 200 lbs ! They are very social animals and can be found in groups of 100 strong, however usually the groups range from 10 -20. Preferred prey of anacondas, jaguars, ocelots, pumas, and caimans, they have a young average life span of just four years. As herbivores, they pose no danger to humans.

**Amazon Legends & Tribes
Indigenous Tribes
Live in the Amazon
Rainforest**

The words 'Amazon Rainforest' conjure up images of lush green canopies, exotic wildlife and tantalizing rivers meandering out of sight. But this tropical paradise is also home to potentially as many as one million indigenous people that live sustainably on the natural resources of the rainforest, as their ancestors have done for thousands of years. But how do these men and women live in the Amazon basin today? How do their lifestyles differ from our own? And how are they affected by a world that is rapidly changing around them? There are estimated to be over 400 indigenous tribes such as the Yanomamo and Kayapo in the Amazon Rainforest today. Although there are still many things we don't know about their ways of life, we can piece together an image of their day to day lifestyles.

A Brief History of Indigenous Tribes

First however, let's take a step back in time. We know that the Amazon has been inhabited by indigenous groups for at least 11,200 years, and that before the arrival of Europeans in the 16th Century and subsequent persecution of the locals, there were approximately 6.8 million native people (often called the Amerindian population) living in South America. We also know that within the first 100 years of European colonization, this population decreased by a massive 90%. The majority of this huge decline in numbers were lost due to disease - European explorers had brought with them illnesses like small pox, measles and the common cold that the native groups had no immunity to. Those that remained were the tribes that lived deep within the rainforest, or those that were pushed there by European persecution, slavery and warfare. Today, it's not just disease that native groups have to fear, but the problems that arise from legal and illegal exploitation of the forest. Drug trafficking, logging, rubber tapping, mining, ranching and other deforestation mean they are under mounting pressure to preserve the lands that have long been their home. Indigenous tribes are on the front-line of those affected by the recent catastrophic fires that have ravaged their lands and livelihoods.

Day To Day Life

Most native Amazonians today live in protected areas of the forest known as indigenous lands where they abide by a combination of traditional and modern means. Some tribes have very much adapted to living near 21st century urban conurbations, making their living through tourism, frequenting local markets for trade, selling handicrafts to tourists, and using western clothing and cooking utensils. Others remain completely shut off from the madness of the modern world - these are known as 'uncontacted tribes' (scroll down for more). Tribal peoples houses are generally communal structures made from wood, bamboo and straw. Sometimes these round huts can accommodate up to 400 people! Each family has their own fire within these structures, and hammocks strung up around it. In the center there is an area that is used for feasts and displays. Tribes normally make decisions communally, holding huge discussions where everyone is allowed a voice. Agriculture and hunting are still crucial skills that are taught to children from an early age. Capybaras, tapirs, crocodiles, monkeys, deer, fish and turtles are all fair game, and are hunted with blowguns, poison-tipped arrows, spears, traps and more recently guns (if they can be afforded). Over the millennia, indigenous people have accumulated a wealth of expertise on how to coexist sustainably with the wild, skillfully managing the biodiversity of the forest. Groups either live in the riverside areas that flood in the rainy season (called the 'varzea') or on terra firme (dry land further into the forest). Those in the varzea harvest crops like beans, bananas, wild rice and manioc, making the most of the highly fertile soil, and rich supply of game.

Effect of climate

Lightning-sparked wildfires are frequent occurrences during the dry summer season in Nevada

A wildfire in Venezuela during a drought Heat waves, droughts, climate variability such as El Niño, and regional weather patterns such as high-pressure ridges can increase the risk and alter the behavior of wildfires dramatically. Years of precipitation followed by warm periods can encourage more widespread fires and longer fire seasons. Since the mid-1980s, earlier snowmelt and associated warming has also been associated with an increase in length and severity of the wildfire season, or the most fire-prone time of the year, in the Western United States. Global warming may increase the intensity and frequency of droughts in many areas, creating more intense and frequent wildfires. A 2015 study indicates that the increase in fire risk in California may be attributable to human-induced climate change. A study of alluvial sediment deposits going back over 8,000 years found warmer climate periods experienced severe droughts and stand-replacing fires and concluded climate was such a powerful influence on wildfire that trying to recreate pre settlement forest structure is likely impossible in a warmer future. Intensity also increases during daytime hours. Burn rates of smoldering logs are up to five times greater during the day due to lower humidity, increased temperatures, and increased wind speeds. Sunlight warms the ground during the day which creates air currents that travel uphill. At night the land cools, creating air currents that travel downhill. Wildfires are fanned by these winds and often follow the air currents over hills and through valleys. Fires in Europe occur frequently during the hours of 12:00 p.m. and 2:00 p.m. Wildfire suppression operations in the United States revolve around a 24-hour fire day that begins at 10:00 a.m. due to the predictable increase in intensity resulting from the daytime warmth. In 2019 extreme heat and dryness caused massive wildfires in

Siberia, Alaska Canary Islands. In the Amazon rainforest The fires were caused mainly by illegal logging. The smoke from the fires expanded on huge territory including major cities. Scientists warn that if it continue like this, it can lead to disaster.

Fire ecology

Global fires during the year 2008 for the months of August (top image) and February (bottom image), as detected by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite.

Wildfire's occurrence throughout the history of terrestrial life invites conjecture that fire must have had pronounced evolutionary effects on most ecosystems' flora and fauna. Wildfires are common in climates that are sufficiently moist to allow the growth of vegetation but feature extended dry, hot periods. Such places include the vegetated areas of Australia and Southeast Asia, the veld in southern Africa, the fynbos in the Western Cape of South Africa, the forested areas of the United States and Canada, and the Mediterranean Basin. High-severity wildfire creates complex early seral forest habitat (also called "snag forest habitat"), which often has higher species richness and diversity than unburned old forest.[9] Plant and animal species in most types of North American forests evolved with fire, and many of these species depend on wildfires, and particularly high-severity fires, to reproduce and grow. Fire helps to return nutrients from plant matter back to soil, the heat from fire is necessary to the germination of certain types of seeds, and the snags (dead trees) and early successional forests created by high- severity fire create habitat conditions that are beneficial to wildlife. Early successional forests created by high-severity fire support some of the highest levels of native biodiversity found in temperate conifer forests. Post-fire logging has no ecological benefits and many negative impacts

Air quality

If the forest continues to burn, it will release a vast amount of carbon dioxide pollution into the atmosphere," says Adrian Forsyth, PhD, co-founder of the Amazon Conservation Association and executive director of the Andes Amazon Fund.

Night-time levels of particulate matter, small enough to lodge in the lungs, have been found at extremely high levels near the rainforest.. "We are talking about concentrations of up to 20 times the EPA standard," says Douglas Morton, PhD, chief of the Biospheric Sciences Laboratory at NASA's Goddard Space Flight Center. Air quality in the U.S. is not expected to be affected, Morton says. There's also smoke. "The smoke travels a long way," Forsyth says, and that's been true for decades. "Some years you can't fly into countries like Bolivia. There is so much smoke, it shuts off all the air traffic." As the smoke accumulated, the Brazilian city of Sao Paulo, with nearly 12 million residents, darkened at 3 p.m. recently, making headlights necessary. By August 22, NASA's AIRS published maps of increased carbon monoxide and carbon dioxide resulting from Brazil's wildfires. On the same day, the European Union's Copernicus Climate Change Service reported a "discernible spike" in emissions of carbon monoxide and carbon dioxide generated by the fires.

Areas downwind of the fires have become covered with smoke, which can potentially last upwards of months at a time if the fires are left to burn out. Hospitals in cities like Porto Velho had reported over three times the average number of cases of patients suffering from the effects of smoke over the same year-to-year period in August 2019 than in other previous years. Besides hindering breathing, the smoke can exacerbates patients with asthma or bronchitis and have potential cancer risk, generally affecting the youth and elderly the most

Biodiversity

Scientists at the Natural History Museum in London, described how while some forests have adapted to fire as "important part of a forest ecosystem's natural cycle", the Amazon rainforest—which is "made up of lowland, wetland forests"—is "not well-equipped to deal with fire". Other Amazon basin ecosystems, like the Cerrado region, with its "large savannah, and lots of plants there have thick, corky, fire resistant stems", is "fire adapted".

Mazeika Sullivan, associate professor at Ohio State University's School of Environment and Natural Resources, explained that the fires could have a massive toll on wildlife in the short term as many animals in the Amazon are not adapted for extraordinary fires. Sloths, lizards, anteaters, and frogs may unfortunately perish in larger numbers than others due to their small size and lack of mobility. Endemic species, like Milton's titi and Mura's saddleback tamarin, are believed to be beset by the fires. Aquatic species could also be affected due to the fires changing the water chemistry into a state unsuitable for life. Long-term effects could be more catastrophic. Parts of the Amazon rainforest's dense canopy were destroyed by the

fires therefore exposing the lower levels of the ecosystem, which then alters the energy flow of the food chain.

Health Effects, Near and Far

There are immediate impacts from the fires for people living in the area, Cesareo says. About 34 million people live in the Amazon, the World Wildlife Fund estimates, including about 385 groups of indigenous people.

Weather patterns: Rainforests add water to the atmosphere when plants release water from their leaves during photosynthesis. When forests burn, there is less moisture released into the atmosphere, which can mean less rainfall. "There could be impacts to the rainfall patterns as far away as the U.S.," Cesareo says.

Medicine

Quinine was the first effective medicine to treat malaria and came from cinchona trees. Many anti-cancer drugs come from rainforest plants. Compounds from rainforest plants are used in drugs to treat high blood pressure, glaucoma, tuberculosis, and other health problems.

Disease

"When forests are cut down, we often see disease outbreaks," Cesareo says. Researchers have linked the felling of forests to rises in malaria and dengue fever, for instance.

Mental health: "People are messaging me, saying how hopeless they feel as they hear all this news," Rosolie says. Twitter is overflowing with messages of angst and calls to action, some urging people in expletive-laced tweets to care. Said one: "Everything on Earth is dying, the Amazon forest is burning, everyone is hopeless." The hashtag #prayforamazonia has sprung up.

The anxiety driven by climate emergencies is a real health issue, Forsyth says. His three children, who hear about conservation regularly and range in age from 18 to 21, have begun telling him they have no plans to have children. "They believe the planet is headed to a train wreck," he says.

Staying Positive, Taking Action

"This is a chronic emergency," Cesareo says. "Unless there is a change in the enforcement of laws in Brazil, there will continue to be fires set."

Long-term, says NASA's Morton, what is needed is "finding a balance between economic development and conservation."

"This issue has the ability to unite people," Rosolie says. "We really can't afford to look the other way anymore."

The good news is, the Amazon is still 80% intact," Forsyth says. What's needed, he says, is government enforcement to protect the rainforest.

On a personal level, "we all have to reduce our meat consumption," says Jos Barlow, PhD, a professor of conservation science at the University of Lancaster in the U.K., who studies the human impact of rainforest fires. "Not all meats are equally bad; chicken is not as bad as beef."

Voting for public officials devoted to preserving the rainforest can help, he says

For people feeling doomed or helpless, it's important to reclaim a sense of control, says Jessy Warner-Cohen, PhD, a senior psychologist at Northwell Health in Lake Success, NY. "A person can choose to make one environmentally friendly change in their life to help offset the impact of this destruction." For instance, order take-out food one less time per week, as the single-use plastics used in food packaging.

Grass fires are a major concern for firefighters in early spring; they get quickly out of control and can cause serious damage in agricultural and forested lands. Forest fire officials encourage people not to light grass fires or burn debris. Burning dry grass in fields or yard debris can spread to nearby forests.

Consider no-burn options. Many landfills offer designated days when yard debris can be disposed of at little or no cost. Many "how to" publications and advice are available about composting. On-site chipping may be feasible. Limbs and other debris may be piled for wildlife habitat if located where it does not pose a wildfire hazard.

Carelessly lit and tended campfires and smoking are another major concern throughout the burning season.

Every year, countless acres of forests are burned because of human carelessness. To help prevent fires in or near forest land during the forest fire season, the following steps should be followed:

Check local regulations regarding permit requirements and "burn ban" restrictions. These are available from your municipality, fire department or department of natural resources. They may include:

Obtaining a burning permit for burning grass, brush, slash or other debris in or within a prescribed distance of forest land;

A campfire permit and the landowner's permission for an open campfire, cooking fire or bonfire in or near forest land;

A work permit for any work in forest land involving two or ore people. Burn only natural vegetation or untreated wood products.

Burn piles are at least 50 feet from structures and 500 feet from any forest slash. Clear the area around the burn pile of any flammable debris.

Keep firefighting equipment handy - a connected water hose or at least five gallons of water and a shovel should be nearby.

Don't burn if it's too windy to burn - if trees are swaying, flags are extended, or waves appear on open water.

Be prepared to extinguish the fire if it becomes a nuisance. Attend the fire until it is completely out.

Smoking should not be done while moving from one place to another in foresland.

Make sure your butt is out - "dead out!"

Power saws must have a proper muffler and be accompanied by a round point shovel or fire extinguisher.

Cars, trucks and machinery must have proper exhaust systems when operated in or near forest land. Exhaust spark arresters are a requirement on certain machines.

Know your local emergency telephone number if a fire becomes uncontrollable.

Conclusion

Wildfire will continue to affect source water quality resulting to increasing treatment, maintenance and operating costs. Therefore, forest and watershed managers and water suppliers have to be well informed about wildfire impacts so as to develop mitigation strategies to build resiliency to wildfire in water supply. Recommended strategies to be fully developed and implemented, they should collect substantial information about magnitude and timing of post-fire impacts. But the bottom line is that wildfire impacts should be incorporated into routine planning, protection and operations of forests watersheds and water sources.

Recommendations:

Forest managers should ensure proper forest management practices through tree thinning by removing dry trees and branches which act as fuel to fires. They should also have post-wildfire mitigation strategies in place such that proper assessment and monitoring is conducted to minimize causes of forest fires, as well as, establishment of landscape emergency stabilization plans to reduce sediment and ash transport into open water sources. Additionally, forest restoration and rehabilitation on the burnt landscape should be done soon after forest fires to minimize pollutants that could be carried from the area

Watershed managers should introduce source water protection by having restriction to forests watershed having the water sources used for drinking water supply. This way anthropogenic activities that might cause forest fires are eliminated. Proper land management practices should be ensured through close monitoring of all human activities happening such as logging, mining and residential developments. Also, they should implement run-off control measures on the steep landscape such as stream channel erosion controls or using wood-straw mulch on burnt area that is being rehabilitated or restored.

Water Providers should modify their designed treatment infrastructures into robust plants that are able to remove pollutants released by forest fires. There should be constant water quality monitoring to understand the key pollutant sources considering all burnt areas that could be exposing the pollutants to the water reservoirs. Highly optimized treatment processes with highly trained operators having knowledge about wildfire water quality impacts should be considered so as to meet drinking water quality standards during post-wildfire periods.

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